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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/676,645	10/01/2003	Gyung-Su Cho	20067/OPP030889US	7874
34431	7590	04/04/2005	EXAMINER	
HANLEY, FLIGHT & ZIMMERMAN, LLC 20 N. WACKER DRIVE SUITE 4220 CHICAGO, IL 60606			MAGEE, THOMAS J	
			ART UNIT	PAPER NUMBER
			2811	

DATE MAILED: 04/04/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/676,645

Applicant(s)

CHO, GYUNG-SU

Examiner

Thomas J. Magee

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 27 December 2004.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-8 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-8 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of Claims 1 – 8 in Letter of 27 December 2004 is acknowledged.

Claim Rejections – 35 U. S. C. 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1 – 3, 5, and 6 are rejected under 35 U.S.C. 102(e) as being anticipated by Liu et al. (US 6,638,867).

4. Regarding Claim 1, Liu et al. disclose a semiconductor device (60) (Figure 6C) having a pad formed by exposing a predetermined region of a metal line (54) formed over a semiconductor substrate (30), the semiconductor device comprising:

an alloy layer ((58) formed on the metal line (54) exposed through the pad, wherein the alloy is formed from a reaction between the metal line (Col. 6, lines 37 – 40) and a metal (Al) having a melting point less than or equal to 1000 degrees C.

5. Regarding Claim 2, Liu et al. disclose a semiconductor device, wherein the metal line (54) is made of copper (Col. 8, lines 56 – 58).

6. Regarding Claim 3, Liu et al. disclose that the metal having the melting point less than or equal to 1000 degrees C is aluminum (Col. 6, line 36).

7. Regarding Claim 5, Liu et al. disclose a semiconductor device wherein a protection layer of silicon nitride is formed on the metal line except where the pad is formed (62) (Figure 6D) (Col. 6, lines 59 – 63).

8. Regarding Claim 6, Liu et al. disclose a semiconductor device, wherein the copper is filled in a via (54) (Figure 6A).

Claim Rejections – 35 U.S.C. 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office Action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Liu et al., as applied

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to Claims 1 – 3, 5, and 6.

11. Regarding Claim 4, Liu et al. do not disclose that the thickness of the alloy layer is less than a thickness of the metal line. However, parameters such as relative layer thicknesses in the art of semiconductor manufacturing are subject to routine experimentation and optimization to achieve the desired quality during device fabrication. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the metal line and alloy thicknesses in the claimed range to form high quality contact pads.

12. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Liu et al., as applied to Claims 1 – 3, 5, and 6, and further in view of Stumborg et al. (US 6,077,775).

13. Regarding Claim 7, Liu et al. do not disclose a semiconductor device wherein a barrier metal is formed on an interface between the copper and the via made of TaN with a thickness between 200 and 800 Angstroms. Stumborg et al. disclose (Figure 2) that a TaN diffusion barrier layer of thickness in the range, 200 to 250 Angstroms thickness (Col. 5, lines 11 – 17) can be used with copper vias. It would have been obvious to one of ordinary skill in the art at the time of the invention to combine Stumborg et al. with Liu et al. to obtain an effective barrier against copper diffusion.


14. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Liu et al. as applied to Claims 1 – 3, 5, and 6, and further in view of Lee (US 6,551,856 B1).

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15. Regarding Claim 8, Liu et al. do not disclose a semiconductor device, wherein the width of the pad is less than the width of the via. Lee discloses in the Prior Art section, (Figure 1) a (copper) via (Col.2, line 34) with an alloy layer (18) (Al-Cu) (Col. 2, lines 35-36) atop, wherein the width of the pad (exposed top) is less than the width of the via. It would have been obvious to one of ordinary skill in the art at the time of the invention to combine Lee and Liu et al. to reduce residual removal of the copper via in processing/etching steps.

Conclusions

16. Any inquiry concerning this communication or earlier communications from the Examiner should be directed to **Thomas Magee**, whose telephone number is **(571) 272 1658**. The Examiner can normally be reached on Monday through Friday from 8:30AM to 5:00PM (EST). If attempts to reach the Examiner by telephone are unsuccessful, the examiner's supervisor, **Eddie Lee**, can be reached on **(571) 272-1732**. The fax number for the organization where this application or proceeding is assigned is **(703) 872-9306**.



Eddie Lee
SPE TC 2800

Thomas Magee
March 23, 2005